V Engineered Safety Features
A. Containment Spray System (Pressurized Water Reactor)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
A.1-a A.1.1 A.1.2 A.1.3	Piping, fittings and miscellaneous items Piping and fittings up to isolation valve Flow orifice/elements Temperature elements/ indicators	Stainless steel	Chemically treated borated water at temperature < 93°C (200°F)	Crack initiation and growth/ Stress corrosion cracking	Chapter XI.M2, "Water Chemistry," for PWR primary water in EPRI TR-105714	No
E-12	General piping and components	Stainless steel	Treated borated water > 140°F	Cracking	Chapter XI.M2, "Water Chemistry," for PWR primary water in EPRI TR-105714	No
A.1-b A.1.4	Containment spray system Bolting	Carbon steel, low-alloy steel	Air, leaking chemically treated borated water	Loss of material/ Boric acid corrosion	Chapter XI.M10, "Boric Acid Corrosion"	No
E-28	Piping and components external surfaces and bolting	Carbon steel	Air with boric acid leakage	Loss of material/ Boric acid corrosion	Chapter XI.M10, "Boric Acid Corrosion"	No
A.1-c A.1.5	Containment spray system Eductors	Stainless steel	Chemically treated borated water at temperature < 93°C (200°F)	Crack initiation and growth/ Stress corrosion cracking	Chapter XI.M2, "Water Chemistry," for PWR primary water in EPRI TR-105714	No
E-12	General piping and components	Stainless steel	Treated borated water > 140°F	Cracking	Chapter XI.M2, "Water Chemistry," for PWR primary water in EPRI TR-105714	No
A.2-a A.2.1 A.2.2 A.2.3 A.2.4	Headers and spray nozzles Piping and fittings Flow orifice Headers Spray nozzles	Carbon steel	Air	Loss of material/ General corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific

V Engineered Safety Features
A. Containment Spray System (Pressurized Water Reactor)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
E-29	Piping and components internal surfaces	Carbon steel	Air – indoor uncontrolled (Int)	Loss of material/ General corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-26	Ducting, piping and components external surfaces	Carbon steel	Air – indoor uncontrolled (Ext)	Loss of material/ General corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
A.3-a A.3.1	Pump Bowl/casing	Stainless steel	Chemically treated borated water at temperature < 93°C (200°F)	Crack initiation and growth/ Stress corrosion cracking	Chapter XI.M2, "Water Chemistry," for PWR primary water in EPRI TR-105714	No
E-12	General piping and components	Stainless steel	Treated borated water > 140°F	Cracking	Chapter XI.M2, "Water Chemistry," for PWR primary water in EPRI TR-105714	No
A.3-b A.3.2	Pump Bolting	Carbon steel, low-alloy steel	Air, leaking chemically treated borated water	Loss of material/ Boric acid corrosion	Chapter XI.M10, "Boric Acid Corrosion"	No
E-28	Piping and components external surfaces and bolting	Carbon steel	Air with boric acid leakage	Loss of material/ Boric acid corrosion	Chapter XI.M10**, "**Boric Acid Corrosion**"**	No
A.4-a A.4.1	Valves (hand, control, check, motor-operated, and containment isolation) in containment spray system Body and bonnet	Stainless steel	Chemically treated borated water at temperature < 93°C (200°F)	Crack initiation and growth/ Stress corrosion cracking	Chapter XI.M2, "Water Chemistry," for PWR primary water in EPRI TR-105714	No
E-12	General piping and components	Stainless steel	Treated borated water > 140°F	Cracking	Chapter XI.M2, "Water Chemistry," for PWR primary water in EPRI TR-105714	No

Comment: This may need to be made more component specific if a component specific program is required to examine the internal surfaces of the spray piping/components

V Engineered Safety Features
A. Containment Spray System (Pressurized Water Reactor)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
A.4-b A.4.2	Valves (hand, control, check, motor-operated, and containment isolation) in containment spray system Bolting	Carbon steel, low-alloy steel	Air, leaking chemically treated borated water	Loss of material/ Boric acid corrosion	Chapter XI.M10, "Boric Acid Corrosion"	No
E-28	Piping and components external surfaces and bolting	Carbon steel	Air with boric acid leakage	Loss of material/ Boric acid corrosion	Chapter XI.M10, "Boric Acid Corrosion"	No
A.5-a A.5.1	Valves (hand, control and containment isolation) in headers and spray nozzles Body and bonnet	Carbon Steel	Air	Loss of material/ General corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-29	Piping and components internal surfaces	Carbon steel	Air – indoor uncontrolled (Int)	Loss of material/ General corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-26	Ducting, piping and components external surfaces	Carbon steel	Air – indoor uncontrolled (Ext)	Loss of material/ General corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
A.5-b A.5.2	Valves (hand, control and containment isolation) in headers and spray nozzles Bolting	Carbon steel, low-alloy steel	Air, leaking chemically treated borated water	Loss of material/ Boric acid corrosion	Chapter XI.M10, "Boric Acid Corrosion"	No
E-28	Piping and components external surfaces and bolting	Carbon steel	Air with boric acid leakage	Loss of material/ Boric acid corrosion	Chapter XI.M10, "Boric Acid Corrosion"	No
A.6-a A.6.1 A.6.2 A.6.3 A.6.4	Containment spray heat exchanger (serviced by open-cycle cooling water) Bonnet/cover Tubing Shell Case/cover	Carbon steel, stainless steel	Chemically treated borated water on one side and open-cycle cooling water (raw water) on the other side	Loss of material/ General and microbiologically influenced corrosion and biofouling	Chapter XI.M20, "Open-Cycle Cooling Water System"	No

Comment: This may need to be made more component specific if a component specific program is required to examine the internal surfaces of the spray piping/components

Comment: Aging effects for parts not covered in the next two lines are covered by the general entries elsewhere in this table.

V Engineered Safety Features

A. Containment Spray System (Pressurized Water Reactor)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
E-18	Heat exchanger shell side components including tubes	Carbon steel	Raw water	Loss of material and macrofouling	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
E-20	Heat exchanger shell side components including tubes	Stainless steel	Raw water	Loss of material and macrofouling	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
A.6-b A.6.2	Containment spray heat exchanger (serviced by open-cycle cooling water) Tubing	Carbon steel, stainless steel	Chemically treated borated water on one side and open-cycle cooling water (raw water) on the other side	Buildup of deposit/ Biofouling	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
E-21	Heat exchanger tubes (serviced by open-cycle cooling water)	Stainless steel	Raw water	Reduction of heat transfer	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
A.6-c A.6.1 A.6.2 A.6.3 A.6.4	Containment spray heat exchanger (serviced by closed-cycle cooling water) Bonnet/cover Tubing Shell Case/cover	Carbon steel, stainless steel	Chemically treated borated water on tube side and closed-cycle cooling water on shell side	Loss of material/ General, pitting and crevice corrosion	Chapter XI.M21, "Closed-Cycle Cooling Water System"	No
E-17	Heat exchanger shell side components including tubes	Carbon steel	Closed cycle cooling water	Loss of material	Chapter XI.M21, "Closed-Cycle Cooling Water System"	No
E-19	Heat exchanger shell side components including tubes	Stainless steel	Closed cycle cooling water	Loss of material	Chapter XI.M21, "Closed-Cycle Cooling Water System"	No
A.6-d A.6.3 A.6.4 A.6.5	Containment spray heat exchanger Shell Case/cover (external surfaces) Bolting	Carbon steel, low-alloy steel	Air, leaking chemically treated borated water	Loss of material/ Boric acid corrosion	Chapter XI.M10**, "**Boric Acid Corrosion**"**	No

Comment: This includes shell side of tubes. Tube side of Hx will be stainless in treated borated water

Comment: Not clear why carbon steel used for tubes which would see borated water.

V Engineered Safety Features
A. Containment Spray System (Pressurized Water Reactor)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
E-28	Piping and components external surfaces and bolting	Carbon steel	Air with boric acid leakage	Loss of material/ Boric acid corrosion	Chapter XI.M10, "Boric Acid Corrosion"	No

V Engineered Safety Features
B. Standby Gas Treatment Systems (Boiling Water Reactor)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
B.1-a B.1.1 B.1.2	Ductwork Fittings, access doors, and closure bolts Equipment frames and housing	Carbon steel	Internal: occasional exposure to moist air; external: ambient plant air environment	Loss of material/ General corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-25	Ducting, piping and components internal surfaces	Carbon steel	Air indoor uncontrolled (Int)	Loss of material/ General corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-26	Ducting, piping and components external surfaces	Carbon steel	Air – indoor uncontrolled (Ext)	Loss of material/ General corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
B.1-b B.1.3 B.1.4	Ductwork Seals between ducts and fan Seals in dampers and doors	Elastomer (Neoprene)	Internal: occasional exposure to moist air; external: ambient plant air environment	Hardening and loss of strength/ Elastomer degradation	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-06	Elastomer seals	Elastomer	Air – indoor uncontrolled > 95°F (Int)	Change in material properties	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-05	Elastomer seals	Elastomer	Air – indoor uncontrolled (Ext)	Change in material properties	A plant-specific aging management program is to be evaluated.	Yes, plant specific

Comment: Not a specific aging mechanism so not repeated

Comment: Temperature threshold applied to internal environment which is not assumed to be exposed to ultraviolet radiation.

B.2-a B.2.1	Filters Housing and supports	Carbon steel	Internal: occasional exposure to moist air; external: ambient plant air environment	Loss of material/ General corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-25	Ducting, piping and components internal surfaces	Carbon steel	Air – indoor uncontrolled (Int)	Loss of material/ General corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-26	Ducting, piping and components external surfaces	Carbon steel	Air – indoor uncontrolled (Ext)	Loss of material/ General corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
B.2-b B.2.2	Filters Elastomer seals	Elastomers (Neoprene and similar materials)	Occasional exposure to moist air	Hardening and loss of strength/ Elastomer degradation	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-06	Elastomer seals	Elastomer	Air – indoor uncontrolled > 95°F (Int)	Change in material properties	A plant-specific aging management program is to be evaluated.	Yes, plant specific

Engineered Safety Features
C. Containment Isolation Components

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
C.1-a C.1.1 C.1.2	BWR and PWR isolation barriers Valve body and bonnet Pipe penetrations (piping between two isolation valves)	Carbon steel and low-alloy steel	Inside surface: treated or raw water, liquid waste; outside surface: ambient air	Loss of material/ General, pitting, crevice and microbiologically influenced corrosion and biofouling	A plant-specific aging management program is to be evaluated. See IN 85-30 for evidence of microbiologically influenced corrosion.	Yes, plant specific
E-31	Containment isolation piping and components internal surfaces	Carbon steel	Treated water	Loss of material/ General, pitting, and crevice corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-22	Containment isolation piping and components internal surfaces	Carbon steel	Raw water	Macrofouling and loss of material/ General, pitting, crevice and microbiologically influenced corrosion	A plant-specific aging management program is to be evaluated. See IN 85-30 for evidence of microbiologically influenced corrosion.	Yes, plant specific
E-32	Containment isolation piping and components internal surfaces	Carbon steel	Untreated water	Loss of material/ General, pitting, crevice and microbiologically influenced corrosion	A plant-specific aging management program is to be evaluated. See IN 85-30 for evidence of microbiologically influenced corrosion.	Yes, plant specific
E-35	Containment isolation piping and components external surfaces	Carbon steel	Air – indoor uncontrolled (Ext)	Loss of material/ General corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-30	Containment isolation piping and components external surfaces	Carbon steel	Condensation (Ext)	Loss of material/ General, pitting, and crevice corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific

Comment: Treated, raw and untreated water cover the liquid environments in systems with containment penetrations that are otherwise out of scope

Comment: Condensation used here since some systems will carry fluids below dew point temperature

C.1-b C.1.1 C.1.2	BWR and PWR isolation barriers Valve body and bonnet Pipe penetrations (piping between two isolation valves)	Stainless steel	Inside surface: treated or raw water, liquid waste; outside surface: ambient air	Loss of material/ Pitting, crevice and microbiologically influenced corrosion and biofouling	A plant-specific aging management program is to be evaluated. See IN 85-30 for evidence of microbiologically influenced corrosion.	Yes, plant specific
E-33	Containment isolation piping and components internal surfaces	Stainless steel	Treated water	Loss of material/ Pitting and crevice corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-36	Containment isolation piping and components internal surfaces	Stainless steel	Raw water	Macrofouling and loss of material/ General, pitting, crevice and microbiologically influenced corrosion	A plant-specific aging management program is to be evaluated. See IN 85-30 for evidence of microbiologically influenced corrosion.	Yes, plant specific
E-34	Containment isolation piping and components internal surfaces	Stainless steel	Untreated water	Loss of material/ Pitting, crevice and microbiologically influenced corrosion	A plant-specific aging management program is to be evaluated. See IN 85-30 for evidence of microbiologically influenced corrosion.	Yes, plant specific

Comment: Treated water and untreated water cover the liquid environments in systems with containment penetrations that are otherwise out of scope. Outside surface of stainless not covered since NUREG-1801 typically ignores stainless in air or condensation.

V Engineered Safety Features
D1. Emergency Core Cooling System (Pressurized Water Reactor)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
D1.1-a D1.1.1 D1.1.2 D1.1.3 D1.1.4 D1.1.5 D1.1.6	Piping and fittings Core flood system Residual heat removal or shutdown cooling High-pressure safety injection Low-pressure safety injection Connecting lines to chemical and volume control system Spent fuel pool cooling lines to emergency sump	Stainless steel	Chemically treated borated water at temperature < 93°C (200°F)	Crack initiation and growth/ Stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” for PWR primary water in EPRI TR-105714	No
E-12	General piping and components	Stainless steel	Treated borated water > 140°F	Cracking	Chapter XI.M2, “Water Chemistry,” for PWR primary water in EPRI TR-105714	No
D1.1-b D1.1.1 D1.1.2 D1.1.3 D1.1.4 D1.1.5 D1.1.6	Piping and fittings Core flood system Residual heat removal or shutdown cooling High-pressure safety injection Low-pressure safety injection Connecting lines to chemical and volume control system Spent fuel pool cooling lines to emergency sump	Cast austenitic stainless steel	Chemically treated borated water at temperature 25–340°C (77-644°F)	Loss of fracture toughness/ Thermal aging embrittlement	Chapter XI.M12, “Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)”	No
E-11	General piping and components	Cast austenitic stainless steel	Treated borated water > 482°F	Loss of fracture toughness/ Thermal aging embrittlement	Chapter XI.M12, “Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)”	No
D1.1-c D1.1.1 D1.1.2 D1.1.3 D1.1.4	Piping and fittings Core flood system Residual heat removal or shutdown cooling High-pressure safety injection Low-pressure safety injection	Stainless steel	Chemically treated borated water at temperature < 93°C (200°F)	Cumulative fatigue damage/ Fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.3, “Metal Fatigue” for acceptable methods for meeting the requirements of 10 CFR 54.21(c).	Yes, TLAA

V Engineered Safety Features
D1. Emergency Core Cooling System (Pressurized Water Reactor)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
E-13	General piping and components	Stainless steel	Treated borated water	Cumulative fatigue damage	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.3, "Metal Fatigue" for acceptable methods for meeting the requirements of 10 CFR 54.21(c).	Yes, TLAA
D1.1-d D1.1.7	Piping and fittings Bolting for flange connections in items D1.1.1 through D1.1.6	Nuts: carbon steel; bolts/studs: alloy steel	Air, leaking chemically treated borated water	Loss of material/ Boric acid corrosion	Chapter XI.M10, "Boric Acid Corrosion"	No
E-28	Piping and components external surfaces and bolting	Carbon steel	Air with boric acid leakage	Loss of material/ Boric acid corrosion	Chapter XI.M10**, "**Boric Acid Corrosion**"**	No
D1.2-a D1.2.1	HPSI and LPSI pumps Bowl/casing	Stainless steel, carbon steel with stainless steel cladding	Chemically treated borated water at temperature < 93°C (200°F)	Crack initiation and growth/ Stress corrosion cracking	Chapter XI.M2, "Water Chemistry," for PWR primary water in EPRI TR-105714	No
E-12	General piping and components	Stainless steel	Treated borated water > 140°F	Cracking	Chapter XI.M2, "Water Chemistry," for PWR primary water in EPRI TR-105714	No
D1.2-b D1.2.1 D1.2.2	HPSI and LPSI pumps Bowl/casing (external surfaces) Bolting	Casing: carbon steel with stainless steel cladding; nuts: carbon steel; bolts/studs: alloy steel	Air, leaking chemically treated borated water	Loss of material/ Boric acid corrosion	Chapter XI.M10, "Boric Acid Corrosion"	No

V Engineered Safety Features
D1. Emergency Core Cooling System (Pressurized Water Reactor)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
E-28	Piping and components external surfaces and bolting	Carbon steel	Air with boric acid leakage	Loss of material/ Boric acid corrosion	Chapter XI.M10, "Boric Acid Corrosion"	No
D1.2-c D1.2.3	HPSI and LPSI pumps Orifice (miniflow recirculation)	Stainless steel	Chemically treated borated water at temperature < 93°C (200°F)	Loss of material/ Erosion	A plant-specific aging management program is to be evaluated for erosion of the orifice due to extended use of the centrifugal HPSI pump for normal charging. See LER 50-275/94-023 for evidence of erosion.	Yes, plant specific
E-24	Orifice (miniflow recirculation)	Stainless steel	Treated borated water	Loss of material/ Erosion	A plant-specific aging management program is to be evaluated for erosion of the orifice due to extended use of the centrifugal HPSI pump for normal charging. See LER 50-275/94-023 for evidence of erosion.	Yes, plant specific
D1.3-a D1.3.1	RWT circulation pump Bolting	Nuts: carbon steel; bolts/studs: alloy steel	Air, leaking chemically treated borated water	Loss of material/ Boric acid corrosion	Chapter XI.M10, "Boric Acid Corrosion"	No
E-28	Piping and components external surfaces and bolting	Carbon steel	Air with boric acid leakage	Loss of material/ Boric acid corrosion	Chapter XI.M10, "Boric Acid Corrosion"	No
D1.4-a D1.4.1	Valves (check, control, hand, motor operated, and relief valves) Body and bonnet	Stainless steel, carbon steel with stainless steel cladding	Chemically treated borated water at temperature < 93°C (200°F)	Cumulative fatigue damage/ Fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.3, "Metal Fatigue" for acceptable methods for meeting the requirements of 10 CFR 54.21(c).	Yes, TLAA

V Engineered Safety Features
D1. Emergency Core Cooling System (Pressurized Water Reactor)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
E-13	General piping and components	Stainless steel	Treated borated water	Cumulative fatigue damage	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.3, "Metal Fatigue" for acceptable methods for meeting the requirements of 10 CFR 54.21(c).	Yes, TLAA
D1.4-b D1.4.1	Valves (check, control, hand, motor operated, and relief valves) Body and bonnet	Stainless steel, carbon steel with stainless steel cladding	Chemically treated borated water at temperature < 93°C (200°F)	Crack initiation and growth/ Stress corrosion cracking	Chapter XI.M2, "Water Chemistry," for PWR primary water in EPRI TR-105714	No
E-12	General piping and components	Stainless steel	Treated borated water > 140°F	Cracking	Chapter XI.M2, "Water Chemistry," for PWR primary water in EPRI TR-105714	No
D1.4-c D1.4.1 D1.4.2	Valves (check, control, hand, motor operated, and relief valves) Body and bonnet (external surfaces) Bolting	Body and bonnet: carbon steel; nuts: carbon steel; bolts/studs: alloy steel	Air, leaking chemically treated borated water	Loss of material/ Boric acid corrosion	Chapter XI.M10, "Boric Acid Corrosion"	No
E-28	Piping and components external surfaces and bolting	Carbon steel	Air with boric acid leakage	Loss of material/ Boric acid corrosion	Chapter XI.M10, "Boric Acid Corrosion"	No

V Engineered Safety Features
D1. Emergency Core Cooling System (Pressurized Water Reactor)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
D1.5-a D1.5.1 D1.5.2 D1.5.3 D1.5.4	Heat exchangers (reactor coolant pump seal, HPSI pump seal, LPSI pump seal, RHR or SDC) Bonnet/cover Tubing Shell Case/cover	Bonnet/ cover and tubing: stainless steel; shell: carbon steel; case/cover: cast iron	Chemically treated borated water; and treated component cooling water	Loss of material/ Pitting and crevice corrosion	Chapter XI.M21, "Closed-Cycle Cooling Water System"	No
E-17	Heat exchanger shell side components including tubes	Carbon steel	Closed cycle cooling water	Loss of material	Chapter XI.M21, "Closed-Cycle Cooling Water System"	No
E-19	Heat exchanger shell side components including tubes	Stainless steel	Closed cycle cooling water	Loss of material	Chapter XI.M21, "Closed-Cycle Cooling Water System"	No
D1.5-b D1.5.3 D1.5.4 D1.5.5	Heat exchangers (RCP seal, HPSI pump seal, LPSI pump seal, RHR or SDC) Shell Case/cover (external surfaces) Bolting	Shell: carbon steel; case/cover: cast iron; nuts: carbon steel; bolts/studs: alloy steel	Air, leaking chemically treated borated water	Loss of material/ Boric acid corrosion	Chapter XI.M10, "Boric Acid Corrosion"	No
E-28	Piping and components external surfaces and bolting	Carbon steel	Air with boric acid leakage	Loss of material/ Boric acid corrosion	Chapter XI.M10, "Boric Acid Corrosion"	No
D1.6-a D1.6.1 D1.6.2 D1.6.3	Heat exchanger (RWT heating) serviced by closed-cycle cooling water Bonnet/cover Tubing Shell	Bonnet/ cover and tubing: stainless steel; shell: carbon steel	Chemically treated borated water and treated component cooling water	Loss of material/ Pitting and crevice corrosion	Chapter XI.M21, "Closed-Cycle Cooling Water System"	No
E-17	Heat exchanger shell side components including tubes	Carbon steel	Closed cycle cooling water	Loss of material and macrofouling	Chapter XI.M21, "Closed-Cycle Cooling Water System"	No
E-19	Heat exchanger shell side components including tubes	Stainless steel	Closed cycle cooling water	Loss of material and macrofouling	Chapter XI.M21, "Closed-Cycle Cooling Water System"	No

Comment: LOM for inside of tubes (stainless in treated borated water not addressed.

Comment: LOM for inside of tubes (stainless in treated borated water not addressed.

V Engineered Safety Features
D1. Emergency Core Cooling System (Pressurized Water Reactor)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
D1.6-b D1.6.1 D1.6.2 D1.6.3	Heat exchanger (RWT Heating) serviced by open-cycle cooling water Bonnet/cover Tubing Shell	Carbon steel, stainless steel	Chemically treated borated water on one side and open-cycle cooling water (raw water) on the other side	Loss of material/ General (carbon steel only), pitting, crevice, and microbiologically influenced corrosion and biofouling	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
E-18	Heat exchanger shell side components including tubes	Carbon steel	Raw water	Loss of material	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
E-20	Heat exchanger shell side components including tubes	Stainless steel	Raw water	Loss of material	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
D1.6-c D1.6.2	Heat exchanger (RWT heating) serviced by open-cycle cooling water Tubing	Carbon steel, stainless steel	Chemically treated borated water on one side and open-cycle cooling water (raw water) on the other side	Buildup of deposit/ Biofouling	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
E-21	Heat exchanger tubes (serviced by open-cycle cooling water)	Stainless steel	Raw water	Reduction of heat transfer	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
D1.6-d D1.6.3 D1.6.4	Heat exchanger (RWT heating) Shell (external surface) Bolting	Shell: carbon steel; nuts: carbon steel; bolts/studs: alloy steel	Air, leaking chemically treated borated water	Loss of Material/ Boric acid corrosion	Chapter XI.M10, "Boric Acid Corrosion"	No

Comment: Effects of fouling assumed covered in next line of NUREG

Comment: LOM for inside of tubes (stainless in treated borated water not addressed.

Comment: Not clear why carbon steel listed for tubes here

V Engineered Safety Features
D1. Emergency Core Cooling System (Pressurized Water Reactor)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
E-28	Piping and components external surfaces and bolting	Carbon steel	Air with boric acid leakage	Loss of material/ Boric acid corrosion	Chapter XI.M10, "Boric Acid Corrosion"	No
D1.7-a D1.7.1 D1.7.2 D1.7.3	Safety injection tank (accumulator) Shell Manway Penetrations/ nozzles (all external surface)	Carbon steel with stainless steel cladding	Air, leaking chemically treated borated water	Loss of material/ Boric acid corrosion	Chapter XI.M10, "Boric Acid Corrosion"	No
E-28	Piping and components external surfaces and bolting	Carbon steel	Air with boric acid leakage	Loss of material/ Boric acid corrosion	Chapter XI.M10, "Boric Acid Corrosion"	No
D1.7-b D1.7.3	Safety injection tank (accumulator) Penetrations/nozzles	Carbon steel with stainless steel cladding	Chemically treated borated water at temperature < 93°C (200°F)	Crack initiation and growth/ Stress corrosion cracking	Chapter XI.M2, "Water Chemistry," for PWR primary water in EPRI TR-105714	No
E-12	General piping and components	Stainless steel	Treated borated water > 140°F	Cracking	Chapter XI.M2, "Water Chemistry," for PWR primary water in EPRI TR-105714	No
D1.8-a D1.8.1 D1.8.2 D1.8.3	Refueling water tank (RWT) Shell Manhole Penetrations/nozzles	Stainless steel	Chemically treated borated water at temperature < 93°C (200°F)	Crack initiation and growth/ Stress corrosion cracking	Chapter XI.M2, "Water Chemistry," for PWR primary water in EPRI TR-105714	No
E-12	General piping and components	Stainless steel	Treated borated water > 140°F	Cracking	Chapter XI.M2, "Water Chemistry," for PWR primary water in EPRI TR-105714	No

V Engineered Safety Features
D1. Emergency Core Cooling System (Pressurized Water Reactor)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
D1.8-b D1.8.4	Refueling water tank (RWT) Bolting	Nuts: carbon steel; bolts/studs: alloy steel	Air, leaking chemically treated borated water	Loss of material/ Boric acid corrosion	Chapter XI.M10, "Boric Acid Corrosion"	No
E-28	Piping and components external surfaces and bolting	Carbon steel	Air with boric acid leakage	Loss of material/ Boric acid corrosion	Chapter XI.M10, "Boric Acid Corrosion"	No
D1.8-c D1.8.5	Refueling water tank (RWT) Buried portion of tank (outer surface)	Stainless steel	Moisture, water	Loss of material/ Pitting and crevice corrosion	A plant-specific aging management program is to be evaluated for pitting and crevice corrosion of tank bottom because moisture and water can egress under the tank due to cracking of the perimeter seal from weathering.	Yes, plant specific
E-01	Partially encased tanks with breached moisture seal	Stainless steel	Untreated water	Loss of material/ Pitting and crevice corrosion	A plant-specific aging management program is to be evaluated for pitting and crevice corrosion of tank bottom because moisture and water can egress under the tank due to cracking of the perimeter seal from weathering.	Yes, plant specific

Comment: The component, buried portion of tank, implies contact with soil which could include moisture and water. However, the mention of a perimeter seal suggests the tank is encased in some structure that acts as a moisture barrier unless the seal is cracked. Have chosen the latter interpretation and modified the component description accordingly..

Engineered Safety Features
D2. Emergency Core Cooling system (Boiling Water Reactor)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
D2.1-a D2.1.1 D2.1.2 D2.1.3 D2.1.4 D2.1.5 D2.1.6 D2.1.7	Piping and fittings High-pressure coolant injection Reactor core isolation cooling High-pressure core spray Low-pressure core spray Low-pressure coolant injection and residual heat removal Lines to suppression chamber Lines to drywell and suppression chamber spray system	Carbon steel	25–288°C (77-550°F) demineralized water	Loss of material/ General, pitting, and crevice corrosion	Chapter XI.M2, “Water Chemistry,” for BWR water in BWRVIP-29 (EPRI TR-103515) The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	Yes, detection of aging effects is to be evaluated
E-08	General piping and components	Carbon steel	Treated water	Loss of material	Chapter XI.M2, “Water Chemistry,” for BWR water in BWRVIP-29 (EPRI TR-103515) The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	Yes, detection of aging effects is to be evaluated
D2.1-b D2.1.1	Piping and fittings HPCI	Carbon steel, stainless steel	25–288°C (77-550°F) demineralized water	Cumulative fatigue damage/ Fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.3, “Metal Fatigue” for acceptable methods for meeting the requirements of 10 CFR 54.21(c).	Yes, TLAA

Engineered Safety Features
D2. Emergency Core Cooling system (Boiling Water Reactor)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
E-10	General piping and components	Carbon steel	Treated water	Cumulative fatigue damage	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.3, "Metal Fatigue" for acceptable methods for meeting the requirements of 10 CFR 54.21(c).	Yes, TLAA
E-16	General piping and components	Stainless steel	Treated water	Cumulative fatigue damage	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.3, "Metal Fatigue" for acceptable methods for meeting the requirements of 10 CFR 54.21(c).	Yes, TLAA
D2.1-c D2.1.1 D2.1.2 D2.1.3 D2.1.4 D2.1.5 D2.1.6 D2.1.7	Piping and fittings HPCI RCIC HPCS LPCS LPCI and RHR Lines to SC Lines to DSCSS	Stainless steel	25–288°C (77-550°F) demineralized water	Crack initiation and growth/ Stress corrosion cracking, intergranular stress corrosion cracking	Chapter XI.M7, "BWR Stress Corrosion Cracking," and Chapter XI.M2, "Water Chemistry," for BWR water in BWRVIP-29 (EPRI TR-103515)	No
E-12	General piping and components	Stainless steel	Treated borated water > 140°F	Cracking	Chapter XI.M2, "Water Chemistry," for PWR primary water in EPRI TR-105714	No
E-15	General piping and components with 4 inch and larger nominal diameter	Stainless steel	Reactor coolant	Cracking	Chapter XI.M7, "BWR Stress Corrosion Cracking," and Chapter XI.M2, "Water Chemistry," for BWR water in BWRVIP-29 (EPRI TR-103515)	No

Comment: This includes portions of the system within the temperature range of the BWR SCC program

Engineered Safety Features
D2. Emergency Core Cooling system (Boiling Water Reactor)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
D2.1-d D2.1.1 D2.1.2 D2.1.3 D2.1.4 D2.1.5 D2.1.6 D2.1.7	Piping and fittings HPCI RCIC HPCS LPCS LPCI and RHR Lines to SC Lines to DSCSS	Cast austenitic stainless steel	25–288°C (77-550°F) demineralized water	Loss of fracture toughness/ Thermal aging embrittlement	Chapter XI.M12, "Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)"	No
E-11	General piping and components	Cast austenitic stainless steel	Treated water > 482°F	Loss of fracture toughness/ Thermal aging embrittlement	Chapter XI.M12, "Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)"	No
D2.1-e D2.1.8	Piping and fittings Automatic depressurization system	Carbon steel, stainless steel	Moist containment atmosphere (air/nitrogen), steam, or demineralized water	Loss of material/ General (carbon steel only), pitting, and crevice corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-14	Piping and components internal surfaces	Stainless steel	Condensation (Int)	Loss of material/ Pitting, and crevice corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-26	Ducting, piping and components external surfaces	Carbon steel	Air – indoor uncontrolled (Ext)	Loss of material/ General corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-27	Piping and components internal surfaces	Carbon steel	Condensation (Int)	Loss of material/ General, pitting, and crevice corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
D2.1-f D2.1.9 D2.1.10	Piping and fittings Lines to HPCI and RCIC pump turbine Lines from HPCI and RCIC pump turbine to torus or wetwell	Carbon steel	Air and steam up to 320°C (608°F)	Wall thinning/ Flow-accelerated corrosion	Chapter XI.M17, "Flow-Accelerated Corrosion"	No

Comment: This subsystem is assumed to include only piping and components downstream of the relief valves since no high temperature aging effects (fatigue or cracking) are mentioned. Piping upstream would be included in the main steam system.

Comment: External surfaces of stainless components are not addressed since the NUREG does not consider aging effects for stainless in air environments.

Engineered Safety Features
D2. Emergency Core Cooling system (Boiling Water Reactor)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
E-07	General piping and components susceptible to flow-accelerated corrosion	Carbon steel	Air and steam	Loss of material/ Flow-accelerated corrosion	Chapter XI.M17, "Flow-Accelerated Corrosion"	No
D2.2-a D2.2.1 D2.2.2 D2.2.3	Pumps HPCS or HPCI main and booster, LPCS, LPCI or RHR, and RCIC Bowl/casing Suction head Discharge head	Carbon steel casting, carbon steel	25–288°C (77-550°F) demineralized water	Loss of material/ General, pitting, and crevice corrosion	Chapter XI.M2, "Water Chemistry," for BWR water in BWRVIP-29 (EPRI TR-103515) The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	Yes, detection of aging effects is to be evaluated
E-08	General piping and components	Carbon steel	Treated water	Loss of material	Chapter XI.M2, "Water Chemistry," for BWR water in BWRVIP-29 (EPRI TR-103515) The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	Yes, detection of aging effects is to be evaluated
D2.3-a D2.3.1	Valves (check, control, hand, motor operated, and relief valves) Body and bonnet	Carbon steel forging, carbon steel casting	25–288°C (77-550°F) demineralized water	Wall thinning/ Flow-accelerated corrosion	Chapter XI.M17, "Flow-Accelerated Corrosion"	No
E-09	General piping and components susceptible to flow-accelerated corrosion	Carbon steel	Treated water	Loss of material/ Flow-accelerated corrosion	Chapter XI.M17, "Flow-Accelerated Corrosion"	No

Engineered Safety Features
D2. Emergency Core Cooling system (Boiling Water Reactor)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
D2.3-b D2.3.1	Valves (check, control, hand, motor operated, and relief valves) Body and bonnet	Carbon steel forging, carbon steel casting	25–288°C (77-550°F) demineralized water	Loss of material/ General, pitting, and crevice corrosion	Chapter XI.M2, “Water Chemistry,” for BWR water in BWRVIP-29 (EPRI TR-103515) The AMP is to be augmented by verification of its effectiveness of the water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	Yes, detection of aging effects is to be evaluated
E-08	General piping and components	Carbon steel	Treated water	Loss of material	Chapter XI.M2, “Water Chemistry,” for BWR water in BWRVIP-29 (EPRI TR-103515) The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	Yes, detection of aging effects is to be evaluated
D2.3-c D2.3.1	Valves (check, control, hand, motor operated, and relief valves) Body and bonnet	Stainless steel forging, stainless steel casting	25–288°C (77-550°F) demineralized water	Crack initiation and growth/ Stress corrosion cracking	Chapter XI.M7, “BWR Stress Corrosion Cracking,” and Chapter XI.M2, “Water Chemistry,” for BWR water in BWRVIP-29 (EPRI TR-103515)	No
E-12	General piping and components	Stainless steel	Treated borated water > 140°F	Cracking	Chapter XI.M2, “Water Chemistry,” for PWR primary water in EPRI TR-105714	No
E-15	General piping and components with 4 inch and larger nominal diameter	Stainless steel	Reactor coolant	Cracking	Chapter XI.M7, “BWR Stress Corrosion Cracking,” and Chapter XI.M2, “Water Chemistry,” for BWR water in BWRVIP-29 (EPRI TR-103515)	No

Engineered Safety Features
D2. Emergency Core Cooling system (Boiling Water Reactor)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
D2.4-a D2.4.1 D2.4.2 D2.4.3 D2.4.4	Heat exchangers (RHR and LPCI) (serviced by open-cycle cooling water) Tubes Tubesheet Channel head Shell	Carbon steel, stainless steel	Demineralized water on one side; open-cycle cooling water (raw water) on the other side	Loss of material/ General (carbon steel only), pitting, crevice, and microbiologically influenced corrosion, and biofouling	Chapter XI.M20, “Open-Cycle Cooling Water System”	No
E-18	Heat exchanger shell side components including tubes	Carbon steel	Raw water	Loss of material and macrofouling	Chapter XI.M20, “Open-Cycle Cooling Water System”	No
E-20	Heat exchanger shell side components including tubes	Stainless steel	Raw water	Loss of material and macrofouling	Chapter XI.M20, “Open-Cycle Cooling Water System”	No
D2.4-b D2.4.1	Heat exchangers (RHR and LPCI) (serviced by open-cycle cooling water) Tubes	Carbon steel, stainless steel	Demineralized water on one side; open cycle cooling water (raw water) on the other side	Buildup of deposit/ Biofouling	Chapter XI.M20, “Open-Cycle Cooling Water System”	No
E-21	Heat exchanger tubes (serviced by open-cycle cooling water)	Stainless steel	Raw water	Reduction of heat transfer	Chapter XI.M20, “Open-Cycle Cooling Water System”	No
E-23	Heat exchanger tubes (serviced by open-cycle cooling water)	Carbon steel	Raw water	Reduction of heat transfer	Chapter XI.M20, “Open-Cycle Cooling Water System”	No
D2.4-c D2.4.1 D2.4.2 D2.4.3 D2.4.4	Heat exchangers (RHR and LPCI) (serviced by closed-cycle cooling water) Tubes Tubesheet Channel head Shell	Carbon steel, stainless steel	Demineralized water on one side; closed-cycle cooling water (treated water) on the other side	Loss of material/ General (carbon steel only), pitting, and crevice corrosion	Chapter XI.M21, “Closed-Cycle Cooling Water System”	No
E-17	Heat exchanger shell side components including tubes	Carbon steel	Closed cycle cooling water	Loss of material	Chapter XI.M21, “Closed-Cycle Cooling Water System”	No

Engineered Safety Features
D2. Emergency Core Cooling system (Boiling Water Reactor)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
E-19	Heat exchanger shell side components including tubes	Stainless steel	Closed cycle cooling water	Loss of material	Chapter XI.M21, "Closed-Cycle Cooling Water System"	No
D2.5-a D2.5.1 D2.5.2 D2.5.3 D2.5.4	Drywell and suppression chamber spray system Piping and fittings Flow orifice Headers Spray nozzles	Carbon steel	Air	Loss of material/ General corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-29	Piping and components internal surfaces	Carbon steel	Air – indoor uncontrolled (Int)	Loss of material/ General corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-26	Ducting, piping and components external surfaces	Carbon steel	Air – indoor uncontrolled (Ext)	Loss of material/ General corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
D2.5-b D2.5.1 D2.5.2 D2.5.3 D2.5.4	Drywell and suppression chamber spray system Piping and fittings Flow orifice Headers Spray nozzles	Carbon steel	Air	Plugging of flow orifice and spray nozzles/ General corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-04	Drywell and suppression chamber spray system (internal surfaces Flow orifice Spray nozzles	Carbon steel	Air – indoor uncontrolled (Int)	Macrofouling from loss of material/ General corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific

Comment: This may need to be made more component specific if a component specific program is required to examine the internal surfaces of the spray piping/components

Comment: General corrosion of piping fittings and headers covered in previous line. Only orifice and nozzles addressed by aging effect

V Engineered Safety Features
E. Carbon Steel Components

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
E.1-a E.1.1	Carbon steel components (PWRs) External surfaces	Carbon steel, low-alloy steel	Air, leaking and dripping chemically treated borated water up to 340°C (644°F)	Loss of material/ Boric acid corrosion of external surfaces	Chapter XI.M10, "Boric Acid Corrosion"	No
E-28	Piping and components external surfaces and bolting	Carbon steel	Air with boric acid leakage	Loss of material/ Boric acid corrosion	Chapter XI.M10**, "**Boric Acid Corrosion**"**	No
E.1-b E.1.1	Carbon steel components (PWRs and BWRs) External surfaces	Carbon steel, low-alloy steel	Air, moisture, and humidity < 100°C (212°F)	Loss of material/ General corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-26	Ducting, piping and components external surfaces	Carbon steel	Air – indoor uncontrolled (Ext)	Loss of material/ General corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E.2-a E.2.1	Closure bolting In high-pressure or high-temperature systems	Carbon steel, low-alloy steel	Air, moisture, humidity, and leaking fluid	Loss of material/ General corrosion	Chapter XI.M18, "Bolting Integrity"	No
E-02	Closure bolting In high-pressure or high-temperature systems	Carbon steel	Air with steam or water leakage (Ext)	Loss of material	Chapter XI.M18, "Bolting Integrity"	No
E.2-b E.2.1	Closure bolting In high-pressure or high-temperature systems	Carbon steel, low-alloy steel	Air, moisture, humidity, and leaking fluid	Crack initiation and growth/ Cyclic loading, stress corrosion cracking	Chapter XI.M18, "Bolting Integrity"	No
E-03	Closure bolting In high-pressure or high-temperature systems	Carbon steel	Air with steam or water leakage (Ext)	Cracking	Chapter XI.M18, "Bolting Integrity"	No

General Material Types

Material	Description
Aluminum	Pure aluminum
Aluminum alloys	Alloys of aluminum
Carbon steel	For a given environment, carbon steel, alloy steel, and cast iron exhibit the same aging effects, even though the rates of aging may vary. Consequently, these metal types may be considered the same for aging management reviews. Gray cast iron is also susceptible to selective leaching and high strength low alloy steel is also susceptible to stress corrosion cracking. Therefore, when these aging effects are being considered, these materials are specifically mentioned; otherwise they are considered part of the general category of carbon steel. (References 5, 6)
Cast austenitic stainless steel	Cast stainless steels containing ferrite in an austenitic matrix
Copper alloy < 15 % Zn	Copper, copper nickel, brass, bronze <15% Zn, Aluminum bronze < 8% Al – These materials are resistant to stress corrosion cracking, selective leaching and pitting and crevice corrosion. (References 5, 6) May be identified simply as copper alloy when these aging mechanisms are not at issue.
Copper alloy >15% Zn	Copper, brass and other alloys >15% Zn, Aluminum bronze > 8% Al – These materials are susceptible to stress corrosion cracking, selective leaching (except for inhibited brass) and pitting and crevice corrosion. (References 5, 6) May be identified simply as copper alloy when these aging mechanisms are not at issue.
Elastomers	Elastomers include rubber, EPT, EPDM, PTFE, ETFE, viton, vitril, neoprene, silicone elastomer, etc.
Galvanized steel	Zinc coated carbon steel
Glass	All glass materials
Soils	Earthen structures
Nickel-alloy	Nickel based iron alloys such as Alloy 600, Alloy 690, Inconel
Reinforced concrete	Concrete with embedded steel reinforcement

Stainless steel	Wrought or forged austenitic stainless steel

Environment Categories

Environment[1]	Description
Air – indoor controlled (Int/Ext)	Indoor air in a humidity controlled (e.g., air conditioned) environment.
Air – indoor uncontrolled (Int/Ext)	Indoor air on systems with temperatures higher than the dew point – Condensation can occur but only rarely – equipment surfaces are normally dry.
Air – indoor uncontrolled > 95°F (Int/Ext)	Indoor air above thermal stress threshold for elastomers
Air with boric acid leakage	Air and untreated borated water leakage on indoor or outdoor systems with temperatures above or below the dew point
Air with reactor coolant leakage	Air and reactor coolant or steam leakage on high temperature systems
Air with steam or water leakage	Air and untreated steam or water leakage on indoor or outdoor systems with temperatures above or below the dew point
Air – outdoor (Int/Ext)	Exposed to air and local weather conditions including salt spray where applicable
Air and steam	Exposed normally to air and periodically to steam
Condensation (Int/Ext)	Air and condensation on surfaces of indoor systems with temperatures below the dew point – for exterior surfaces and interior surfaces in communication ambient indoor air, condensation is considered untreated water due to potential for surface contamination.
Condensation with boric acid leakage	Air and condensation with the potential for boric acid leakage on surfaces of indoor systems with temperatures below the dew point – condensation is considered untreated water due to potential for surface contamination

[1] For environments listed with (Int/Ext), the component information description should identify whether the surface is internal or external. This information is important because it indicates the applicability of direct visual observation of the surface for aging management. For the remaining environments, this distinction need not be made since the environment must be internal to some barrier that precludes direct observation of the surface.

Closed cycle cooling water	Treated water subject to the closed cycle cooling water chemistry program
Concrete	Components embedded in concrete
Dried Air	Air that has been treated to reduce the dew point well below the system operating temperature
Exhaust gases	Gas present in a diesel engine exhaust
Gas	Inert gases such as carbon dioxide, freon, halon, nitrogen
Fuel oil	Fuel oil used for combustion engines
Lubricating oil	Lubricating oil for plant equipment with possible water contamination
Neutron flux	Reactor core environment for ferritic materials that will result in a neutron fluence exceeding 10^{17} n/cm^2 (E >1 MeV) at the end of the license renewal term.
Raw water	Raw untreated fresh or salt water
Reactor coolant	Water in the reactor coolant system and connected systems at or near full operating temperature – includes steam for BWRs
Reactor coolant > 482°F	Water in the reactor coolant system and connected systems above thermal embrittlement threshold for CASS
Sand and concrete	Sand/concrete base for tanks
Soil	External environment for components buried in the soil, including groundwater in the soil
Secondary feedwater/steam	PWR feedwater or steam at or near full operating temperature subject to the secondary water chemistry program
Steam	Steam, subject to BWR water chemistry program or PWR secondary plant water chemistry program
Treated borated water	Treated water with boric acid

Attachment 2 **ESF Systems**

Treated borated water >140°F	Treated water with boric acid above SCC threshold for stainless steel
Treated borated water >482°F	Treated water with boric acid above thermal embrittlement threshold for CASS
Treated water	Treated or demineralized water – This environment is used where the context of the MEAP combination makes the type of treated water apparent; e.g., if the program is for PWR secondary water chemistry, the treated water is from the PWR secondary system.
Treated water >140°F	Treated water above SCC threshold for stainless steel
Treated water >482°F	Treated water above thermal embrittlement threshold for CASS
Untreated water	Water that may contain contaminants including oil and boric acid depending on the location – includes originally treated water that is not monitored by a chemistry program

Temperature Thresholds

Temperature	Threshold	Basis
95°F	Thermal stresses for elastomers	In general, if the ambient temperature is less than about 95°F, then thermal aging may be considered not significant for rubber, butyl rubber, neoprene, nitrile rubber, silicone elastomer, fluoroelastomer, EPR, and EPDM (Reference 8).
140°F	SCC for stainless steel	In general, SCC very rarely occurs in austenitic stainless steels below 140°F (Reference 1, 2). Although SCC has been observed in stagnant, oxygenated borated water systems at lower temperatures than this 140°F threshold, all of these instances have identified a significant presence of contaminants (halogens, specifically chlorides) in the failed components. With a harsh enough environment (significant contamination), SCC can occur in austenitic stainless steel at ambient temperature. However, these conditions are considered event driven, resulting from a breakdown of chemistry controls. Further discussion of this threshold is provided in Reference 7.
482°F	Thermal embrittlement for CASS	CASS materials subjected to sustained temperatures below 250°C (482°F) will not result in a reduction of room temperature Charpy impact energy below 50 ft-lb for exposure times of approximately 300,000 hours (for CASS with ferrite content of 40%) and approximately 2,500,000 hours for CASS with ferrite content of 14%) [Figure 1; Reference 4]. For a maximum exposure time of approximately 420,000 hours (48 EFPY), a screening temperature of 482°F is conservatively chosen because (1) the majority of nuclear grade materials are expected to contain a ferrite content well below 40%, and (2) the 50 ft-lb limit is very conservative when applied to cast austenitic materials. It is typically applied to ferritic materials (e.g., 10 CFR 50 Appendix G). For CASS components in the reactor coolant pressure boundary, this threshold is supported by NUREG-1801 XI.M12, with the exception of niobium-containing steels which require evaluation on a case-by-case basis.

Attachment 2 **ESF Systems**

New Aging Effect Terms

Change in material properties	This effect covers all degradation of a material's properties considered important for its intended function
Reduction of heat transfer	Reduction of heat transfer from fouling by the buildup (from whatever source) on the heat transfer surface.
Macrofouling	Biofouling listed in NUREG-1801 as aging mechanism is assumed to be the plugging of components due to biological growth or material. Although plugging of a component affects only flow, an active intended function outside the purview of license renewal, the term macrofouling is used to address fouling that causes plugging as opposed to fouling that causes loss of heat transfer, and includes plugging from any source, including biological.

References

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3. Not Used
4. R. Nickell, M. A. Rinckel, “Evaluation of Thermal Aging Embrittlement for Cast Austenitic Stainless Steel Components,” TR-106092, Research Project 2643-33, Final Report, March 1996.
5. Metals Handbook, Desk Edition, American Society for Metals, Materials Park, OH, 1985.
6. M. G. Fontana, Corrosion Engineering, Third Edition, Copyright 1986, McGraw Hill.
7. License Renewal Application for St. Lucie Units 1 and 2, November 30, 2001, Appendix C.
8. Aging Management Guideline for Commercial Nuclear Power Plants – Electrical and Mechanical Penetrations, EPRI, Palo Alto, CA: 2002. 1003456

V Engineered Safety Features
A. Containment Spray System (Pressurized Water Reactor)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
E-26	Ducting, piping and components external surfaces	Carbon steel	Air – indoor uncontrolled (Ext)	Loss of material/ General corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-12	General piping and components	Stainless steel	Treated borated water > 140°F	Cracking	Chapter XI.M2, "Water Chemistry," for PWR primary water in EPRI TR-105714	No
E-17	Heat exchanger shell side components including tubes	Carbon steel	Closed cycle cooling water	Loss of material	Chapter XI.M21, "Closed-Cycle Cooling Water System"	No
E-18	Heat exchanger shell side components including tubes	Carbon steel	Raw water	Loss of material and macrofouling	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
E-19	Heat exchanger shell side components including tubes	Stainless steel	Closed cycle cooling water	Loss of material	Chapter XI.M21, "Closed-Cycle Cooling Water System"	No
E-20	Heat exchanger shell side components including tubes	Stainless steel	Raw water	Loss of material and macrofouling	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
E-21	Heat exchanger tubes (serviced by open-cycle cooling water)	Stainless steel	Raw water	Reduction of heat transfer	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
E-28	Piping and components external surfaces and bolting	Carbon steel	Air with boric acid leakage	Loss of material/ Boric acid corrosion	Chapter XI.M10**, "**Boric Acid Corrosion**"**	No
E-29	Piping and components internal surfaces	Carbon steel	Air – indoor uncontrolled (Int)	Loss of material/ General corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific

V Engineered Safety Features
B. Standby Gas Treatment Systems (Boiling Water Reactor)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
E-26	Ducting, piping and components external surfaces	Carbon steel	Air – indoor uncontrolled (Ext)	Loss of material/ General corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-25	Ducting, piping and components internal surfaces	Carbon steel	Air – indoor uncontrolled (Int)	Loss of material/ General corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-05	Elastomer seals	Elastomer	Air – indoor uncontrolled (Ext)	Change in material properties	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-06	Elastomer seals	Elastomer	Air – indoor uncontrolled > 95°F (Int)	Change in material properties	A plant-specific aging management program is to be evaluated.	Yes, plant specific

Engineered Safety Features
C. Containment Isolation Components

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
E-35	Containment isolation piping and components external surfaces	Carbon steel	Air – indoor uncontrolled (Ext)	Loss of material/ General corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-30	Containment isolation piping and components external surfaces	Carbon steel	Condensation (Ext)	Loss of material/ General, pitting, and crevice corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-22	Containment isolation piping and components internal surfaces	Carbon steel	Raw water	Macrofouling and loss of material/ General, pitting, crevice and microbiologically influenced corrosion	A plant-specific aging management program is to be evaluated. See IN 85-30 for evidence of microbiologically influenced corrosion.	Yes, plant specific
E-31	Containment isolation piping and components internal surfaces	Carbon steel	Treated water	Loss of material/ General, pitting, and crevice corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-32	Containment isolation piping and components internal surfaces	Carbon steel	Untreated water	Loss of material/ General, pitting, crevice and microbiologically influenced corrosion	A plant-specific aging management program is to be evaluated. See IN 85-30 for evidence of microbiologically influenced corrosion.	Yes, plant specific
E-36	Containment isolation piping and components internal surfaces	Stainless steel	Raw water	Macrofouling and loss of material/ General, pitting, crevice and microbiologically influenced corrosion	A plant-specific aging management program is to be evaluated. See IN 85-30 for evidence of microbiologically influenced corrosion.	Yes, plant specific
E-33	Containment isolation piping and components internal surfaces	Stainless steel	Treated water	Loss of material/ Pitting and crevice corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific

E-34	Containment isolation piping and components internal surfaces	Stainless steel	Untreated water	Loss of material/ Pitting, crevice and microbiologically influenced corrosion	A plant-specific aging management program is to be evaluated. See IN 85-30 for evidence of microbiologically influenced corrosion.	Yes, plant specific

V Engineered Safety Features
D1. Emergency Core Cooling System (Pressurized Water Reactor)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
E-11	General piping and components	Cast austenitic stainless steel	Treated borated water > 482°F	Loss of fracture toughness/ Thermal aging embrittlement	Chapter XI.M12, "Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)"	No
E-12	General piping and components	Stainless steel	Treated borated water > 140°F	Cracking	Chapter XI.M2, "Water Chemistry," for PWR primary water in EPRI TR-105714	No
E-13	General piping and components	Stainless steel	Treated borated water	Cumulative fatigue damage	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.3, "Metal Fatigue" for acceptable methods for meeting the requirements of 10 CFR 54.21(c).	Yes, TLAA
E-17	Heat exchanger shell side components including tubes	Carbon steel	Closed cycle cooling water	Loss of material and macrofouling	Chapter XI.M21, "Closed-Cycle Cooling Water System"	No
E-18	Heat exchanger shell side components including tubes	Carbon steel	Raw water	Loss of material	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
E-19	Heat exchanger shell side components including tubes	Stainless steel	Closed cycle cooling water	Loss of material and macrofouling	Chapter XI.M21, "Closed-Cycle Cooling Water System"	No
E-20	Heat exchanger shell side components including tubes	Stainless steel	Raw water	Loss of material	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
E-21	Heat exchanger tubes (serviced by open-cycle cooling water)	Stainless steel	Raw water	Reduction of heat transfer	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
E-24	Orifice (miniflow recirculation)	Stainless steel	Treated borated water	Loss of material/ Erosion	A plant-specific aging management program is to be evaluated for erosion of the orifice due to extended use of the centrifugal HPSI pump for normal charging. See LER 50-275/94-023 for evidence of erosion.	Yes, plant specific

V Engineered Safety Features
D1. Emergency Core Cooling System (Pressurized Water Reactor)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
E-01	Partially encased tanks with breached moisture seal	Stainless steel	Untreated water	Loss of material/ Pitting and crevice corrosion	A plant-specific aging management program is to be evaluated for pitting and crevice corrosion of tank bottom because moisture and water can egress under the tank due to cracking of the perimeter seal from weathering.	Yes, plant specific
E-28	Piping and components external surfaces and bolting	Carbon steel	Air with boric acid leakage	Loss of material/ Boric acid corrosion	Chapter XI.M10, "Boric Acid Corrosion"	No

Engineered Safety Features
D2. Emergency Core Cooling system (Boiling Water Reactor)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
E-04	Drywell and suppression chamber spray system (internal surfaces Flow orifice Spray nozzles	Carbon steel	Air – indoor uncontrolled (Int)	Macrofouling from loss of material/ General corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-26	Ducting, piping and components external surfaces	Carbon steel	Air – indoor uncontrolled (Ext)	Loss of material/ General corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-08	General piping and components	Carbon steel	Treated water	Loss of material	Chapter XI.M2, “Water Chemistry,” for BWR water in BWRVIP-29 (EPRI TR-103515) The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	Yes, detection of aging effects is to be evaluated
E-10	General piping and components	Carbon steel	Treated water	Cumulative fatigue damage	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.3, “Metal Fatigue” for acceptable methods for meeting the requirements of 10 CFR 54.21(c).	Yes, TLAA
E-11	General piping and components	Cast austenitic stainless steel	Treated water > 482°F	Loss of fracture toughness/ Thermal aging embrittlement	Chapter XI.M12, “Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)”	No
E-12	General piping and components	Stainless steel	Treated borated water > 140°F	Cracking	Chapter XI.M2, “Water Chemistry,” for PWR primary water in EPRI TR-105714	No

Engineered Safety Features
D2. Emergency Core Cooling system (Boiling Water Reactor)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
E-16	General piping and components	Stainless steel	Treated water	Cumulative fatigue damage	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.3, "Metal Fatigue" for acceptable methods for meeting the requirements of 10 CFR 54.21(c).	Yes, TLAA
E-15	General piping and components with 4 inch and larger nominal diameter	Stainless steel	Reactor coolant	Cracking	Chapter XI.M7, "BWR Stress Corrosion Cracking," and Chapter XI.M2, "Water Chemistry," for BWR water in BWRVIP-29 (EPRI TR-103515)	No
E-07	General piping and components susceptible to flow-accelerated corrosion	Carbon steel	Air and steam	Loss of material/ Flow-accelerated corrosion	Chapter XI.M17, "Flow-Accelerated Corrosion"	No
E-09	General piping and components susceptible to flow-accelerated corrosion	Carbon steel	Treated water	Loss of material/ Flow-accelerated corrosion	Chapter XI.M17, "Flow-Accelerated Corrosion"	No
E-17	Heat exchanger shell side components including tubes	Carbon steel	Closed cycle cooling water	Loss of material	Chapter XI.M21, "Closed-Cycle Cooling Water System"	No
E-18	Heat exchanger shell side components including tubes	Carbon steel	Raw water	Loss of material and macrofouling	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
E-19	Heat exchanger shell side components including tubes	Stainless steel	Closed cycle cooling water	Loss of material	Chapter XI.M21, "Closed-Cycle Cooling Water System"	No
E-20	Heat exchanger shell side components including tubes	Stainless steel	Raw water	Loss of material and macrofouling	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
E-23	Heat exchanger tubes (serviced by open-cycle cooling water)	Carbon steel	Raw water	Reduction of heat transfer	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
E-21	Heat exchanger tubes (serviced by open-cycle cooling water)	Stainless steel	Raw water	Reduction of heat transfer	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
E-29	Piping and components internal surfaces	Carbon steel	Air – indoor uncontrolled (Int)	Loss of material/ General corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific

Engineered Safety Features
D2. Emergency Core Cooling system (Boiling Water Reactor)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
E-27	Piping and components internal surfaces	Carbon steel	Condensation (Int)	Loss of material/ General, pitting, and crevice corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-14	Piping and components internal surfaces	Stainless steel	Condensation (Int)	Loss of material/ Pitting, and crevice corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific

V Engineered Safety Features
E. Carbon Steel Components

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
E-02	Closure bolting In high-pressure or high-temperature systems	Carbon steel	Air with steam or water leakage (Ext)	Loss of material	Chapter XI.M18, “Bolting Integrity”	No
E-03	Closure bolting In high-pressure or high-temperature systems	Carbon steel	Air with steam or water leakage (Ext)	Cracking	Chapter XI.M18, “Bolting Integrity”	No
E-26	Ducting, piping and components external surfaces	Carbon steel	Air – indoor uncontrolled (Ext)	Loss of material/ General corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-28	Piping and components external surfaces and bolting	Carbon steel	Air with boric acid leakage	Loss of material/ Boric acid corrosion	Chapter XI.M10**, “**Boric Acid Corrosion**”**	No

V Engineered Safety Features
Additional MEAP Combinations Not Currently Addressed by NUREG-1801

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
	Bolting	Carbon steel	Air – outdoor (Ext)	Loss of material	Chapter XI.M18, "Bolting Integrity"	No
	General piping and components	Aluminum	Air with boric acid leakage	Loss of material/ Boric acid corrosion	Chapter XI.M10**, "**Boric Acid Corrosion**"**	No
	General piping and components	Aluminum	Air – indoor uncontrolled (Int/Ext)	None	None	
	General piping and components	Carbon steel	Air – indoor controlled (Ext)	None	None	
	General piping and components	Carbon steel	Concrete	None	None	
	General piping and components	Carbon steel	Lubricating oil (no water pooling)	None	None	
	General piping and components	Carbon steel	Gas	None	None	
	General piping and components	Cast austenitic stainless steel	Air – indoor uncontrolled (Ext)	None	None	
	General piping and components	Copper alloy	Gas	None	None	
	General piping and components	Copper-alloy	Air – indoor uncontrolled (Ext)	None	None	
	General piping and components	Copper-alloy	Lubricating oil (no water pooling)	None	None	
	General piping and components	Copper-alloy <15 % Zn	Air with boric acid leakage	None	None	
	General piping and components	Copper-alloy <15 % Zn	Closed cycle cooling water	Loss of material	Chapter XI.M21, "Closed-Cycle Cooling Water System"	No
	General piping and components	Galvanized steel	Air – indoor uncontrolled (Ext)	None	None	
	General piping and components	Glass	Air – indoor uncontrolled (Ext)	None	None	
	General piping and components	Glass	Lubricating oil	None	None	
	General piping and components	Nickel-alloy	Air – indoor uncontrolled (Ext)	None	None	
	General piping and components	Stainless steel	Air – indoor uncontrolled (Ext)	None	None	
	General piping and components	Stainless steel	Air with boric acid leakage	None	None	

V Engineered Safety Features
Additional MEAP Combinations Not Currently Addressed by NUREG-1801

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
	General piping and components	Stainless steel	Concrete	None	None	
	General piping and components	Stainless steel	Lubricating oil	None	None	
	General piping and components	Stainless steel	Gas	None	None	
	General piping and components	Stainless steel	Treated borated water	Loss of material	Chapter XI.M2, “Water Chemistry,” for PWR primary water in EPRI TR-105714	No

Line	Items	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
E-01	D1.8-c	Partially encased tanks with breached moisture seal	Stainless steel	Untreated water	Loss of material/ Pitting and crevice corrosion	A plant-specific aging management program is to be evaluated for pitting and crevice corrosion of tank bottom because moisture and water can egress under the tank due to cracking of the perimeter seal from weathering.	Yes, plant specific
E-02	E.2-a	Closure bolting In high-pressure or high-temperature systems	Carbon steel	Air with steam or water leakage	Loss of material	Chapter XI.M18, “Bolting Integrity”	No
E-03	E.2-b	Closure bolting In high-pressure or high-temperature systems	Carbon steel	Air with steam or water leakage	Cracking	Chapter XI.M18, “Bolting Integrity”	No
E-04	D2.5-b	Drywell and suppression chamber spray system (internal surfaces Flow orifice Spray nozzles	Carbon steel	Air – indoor uncontrolled (Int)	Macrofouling from loss of material/ General corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-05	B.1-b	Elastomer seals	Elastomer	Air – indoor uncontrolled (Ext)	Change in material properties	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-06	B.1-b B.2-b	Elastomer seals	Elastomer	Air – indoor uncontrolled > 95°F (Int)	Change in material properties	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-07	D2.1-f	General piping and components susceptible to flow-accelerated corrosion	Carbon steel	Air and steam	Loss of material/ Flow-accelerated corrosion	Chapter XI.M17, “Flow-Accelerated Corrosion”	No
E-08	D2.1-a D2.2-a D2.3-b	General piping and components	Carbon steel	Treated water	Loss of material	Chapter XI.M2, “Water Chemistry,” for BWR water in BWRVIP-29 (EPRI TR-103515) The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	Yes, detection of aging effects is to be evaluated

Line	Items	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
E-09	D2.3-a	General piping and components susceptible to flow-accelerated corrosion	Carbon steel	Treated water	Loss of material/ Flow-accelerated corrosion	Chapter XI.M17, “Flow-Accelerated Corrosion”	No
E-10	D2.1-b	General piping and components	Carbon steel	Treated water	Cumulative fatigue damage	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.3, “Metal Fatigue” for acceptable methods for meeting the requirements of 10 CFR 54.21(c).	Yes, TLAA
E-11	D1.1-b D2.1-d	General piping and components	Cast austenitic stainless steel	Treated borated water > 482°F	Loss of fracture toughness/ Thermal aging embrittlement	Chapter XI.M12, “Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)”	No
E-12	A.1-a A.1-c A.3-a A.4-a D1.1-a D1.2-a D1.4-b D1.7-b D1.8-a D2.1-c D2.3-c	General piping and components	Stainless steel	Treated borated water > 140°F	Cracking	Chapter XI.M2, “Water Chemistry,” for PWR primary water in EPRI TR-105714	No
E-13	D1.1-c D1.4-a	General piping and components	Stainless steel	Treated borated water	Cumulative fatigue damage	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.3, “Metal Fatigue” for acceptable methods for meeting the requirements of 10 CFR 54.21(c).	Yes, TLAA
E-14	D2.1-e	Piping and components internal surfaces	Stainless steel	Condensation	Loss of material/ Pitting, and crevice corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific

Line	Items	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
E-15	D2.1-c D2.3-c	General piping and components with 4 inch and larger nominal diameter	Stainless steel	Reactor coolant	Cracking	Chapter XI.M7, “BWR Stress Corrosion Cracking,” and Chapter XI.M2, “Water Chemistry,” for BWR water in BWRVIP-29 (EPRI TR-103515)	No
E-16	D2.1-b	General piping and components	Stainless steel	Treated water	Cumulative fatigue damage	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.3, “Metal Fatigue” for acceptable methods for meeting the requirements of 10 CFR 54.21(c).	Yes, TLAA
E-17	A.6-c D1.5-a D1.6-a D2.4-c	Heat exchanger shell side components including tubes	Carbon steel	Closed cycle cooling water	Loss of material	Chapter XI.M21, “Closed-Cycle Cooling Water System”	No
E-18	A.6-a D1.6-b D2.4-a	Heat exchanger shell side components including tubes	Carbon steel	Raw water	Loss of material and macrofouling	Chapter XI.M20, “Open-Cycle Cooling Water System”	No
E-19	A.6-c D1.5-a D1.6-a D2.4-c	Heat exchanger shell side components including tubes	Stainless steel	Closed cycle cooling water	Loss of material	Chapter XI.M21, “Closed-Cycle Cooling Water System”	No
E-20	A.6-a D1.6-b D2.4-a	Heat exchanger shell side components including tubes	Stainless steel	Raw water	Loss of material and macrofouling	Chapter XI.M20, “Open-Cycle Cooling Water System”	No
E-21	A.6-b D1.6-c D2.4-b	Heat exchanger tubes (serviced by open-cycle cooling water)	Stainless steel	Raw water	Reduction of heat transfer	Chapter XI.M20, “Open-Cycle Cooling Water System”	No

Line	Items	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
E-22	C.1-a	Containment isolation piping and components internal surfaces	Carbon steel	Raw water	Macrofouling and loss of material/ General, pitting, crevice and microbiologically influenced corrosion	A plant-specific aging management program is to be evaluated. See IN 85-30 for evidence of microbiologically influenced corrosion.	Yes, plant specific
E-23	D2.4-b	Heat exchanger tubes (serviced by open-cycle cooling water)	Carbon steel	Raw water	Reduction of heat transfer	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
E-24	D1.2-c	Orifice (miniflow recirculation)	Stainless steel	Treated borated water	Loss of material/ Erosion	A plant-specific aging management program is to be evaluated for erosion of the orifice due to extended use of the centrifugal HPSI pump for normal charging. See LER 50-275/94-023 for evidence of erosion.	Yes, plant specific
E-25	B.1-a B.2-a	Ducting, piping and components internal surfaces	Carbon steel	Air indoor uncontrolled (Int)	Loss of material/ General corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-26	A.2-a A.5-a B.1-a B.2-a D2.1-e D2.5-a E.1-b	Ducting, piping and components external surfaces	Carbon steel	Air – indoor uncontrolled (Ext)	Loss of material/ General corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-27	D2.1-e	Piping and components internal surfaces	Carbon steel	Condensation (Int)	Loss of material/ General, pitting, and crevice corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific

Comment: Treated, raw and untreated water cover the liquid environments in systems with containment penetrations that are otherwise out of scope

Line	Items	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
E-28	A.1-b A.3-b A.4-b A.5-b A.6-d D1.1-d D1.2-b D1.3-a D1.4-c D1.5-b D1.6-d D1.7-a D1.8-b E.1-a	Piping and components external surfaces and bolting	Carbon steel	Air with boric acid leakage	Loss of material/ Boric acid corrosion	Chapter XI.M10, "Boric Acid Corrosion"	No
E-29	A.2-a A.5-a D2.5-a	Piping and components internal surfaces	Carbon steel	Air – indoor uncontrolled (Int)	Loss of material/ General corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-30	C.1-a	Containment isolation piping and components internal surfaces	Carbon steel	Condensation (Ext)	Loss of material/ General corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-31	C.1-a	Containment isolation piping and components internal surfaces	Carbon steel	Treated water	Loss of material/ General, pitting, and crevice corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-32	C.1-a	Containment isolation piping and components external surfaces	Carbon steel	Untreated water	Loss of material/ General, pitting, crevice and microbiologically influenced corrosion	A plant-specific aging management program is to be evaluated. See IN 85-30 for evidence of microbiologically influenced corrosion.	Yes, plant specific
E-33	C.1-b	Containment isolation piping and components internal surfaces	Stainless steel	Treated water	Loss of material/ Pitting and crevice corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific

Line	Items	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
E-34	C.1-b	Containment isolation piping and components internal surfaces	Stainless steel	Untreated water	Macrofouling and loss of material/ Pitting, crevice and microbiologically influenced corrosion	A plant-specific aging management program is to be evaluated. See IN 85-30 for evidence of microbiologically influenced corrosion.	Yes, plant specific
E-35	C.1-a	Containment isolation piping and components external surfaces	Carbon steel	Air – indoor uncontrolled (Ext)	Loss of material/ General corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant specific
E-36	C.1-b	Containment isolation piping and components internal surfaces	Stainless steel	Raw water	Macrofouling and loss of material/ General, pitting, crevice and microbiologically influenced corrosion	A plant-specific aging management program is to be evaluated. See IN 85-30 for evidence of microbiologically influenced corrosion.	Yes, plant specific